COSEWIC
Assessment and Status Report

on the

Sable Island Sweat Bee
Lasioglossum sablense

in Canada

THREATENED
2014

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC would like to acknowledge Jason Gibbs for writing the status report on the Sable Island Sweat Bee, *Lasioglossum sablense*, in Canada, prepared under contract with Environment Canada. This report was overseen and edited by Jennifer Heron, Co-chair of the COSEWIC Arthropods Specialist Subcommittee.

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Sable Island Sweat Bee — Photograph taken by Jason Gibbs.

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COSEWIC
Assessment Summary

Assessment Summary – November 2014

Common name
Sable Island Sweat Bee

Scientific name
Lasioglossum sablense

Status
Threatened

Reason for designation
This species is globally endemic to Sable Island, Nova Scotia, and occurs as one isolated population with a very small range and no possibility of rescue. The island has only about 13 km^2 of vegetated area that provides forage/nesting sites for this bee. Nesting likely occurs near or within this vegetated area and sweat bees are not known to travel large distances (i.e. > 200 m) for forage. Increased frequency and severity of storms, in addition to climate change and related sea level rise, are expected to drive change which will further decrease the quality and quantity of bee habitat on the island. Eco-tourism is also a potential future threat, which may also increase the introduction and spread of invasive species. Habitat on the island is also susceptible to invasive plant species, introduced horses, and seawater flooding.

Occurrence
Nova Scotia

Status history
Designated Threatened in November 2014.

COSEWIC
Executive Summary

Sable Island Sweat Bee
Lasioglossum sablense

Wildlife Species Description and Significance

The Sable Island Sweat Bee, *Lasioglossum sablense* Gibbs, is a small (5–6 mm), dull-metallic sweat bee in the family Halictidae. The species is endemic to Canada, occurring solely on Sable Island, Nova Scotia. Both sexes can be distinguished from the three other bee species (two of these sweat bees) on Sable Island by the combination of their small size and the dense lateral punctures on the dorsal part of the thorax.

Distribution

The global and Canadian distribution of the species is confined to Sable Island, Nova Scotia, which is approximately 34 km^2 in area, excluding the intertidal zone. The island is isolated from mainland Nova Scotia by a distance of approximately 150 km.

Habitat

Sable Island is primarily composed of sand, with low levels of organic material in the sandy soil. Approximately 13 – 15 km^2 of the island (39%) has vegetation and is considered potential bee habitat. Vegetated areas are composed of a few distinct plant communities, the largest of which are Marram-Forb grasslands, sparse grass lands and heath. Climatic conditions are cool and foggy with high winds during the summer and relatively warm conditions during the winter. Females dig underground nests. Flowering plants are visited for pollen and nectar resources.

Biology

The Sable Island Sweat Bee is a ground-nesting species and a generalist floral visitor. Inseminated females overwinter as adults and emerge in spring to form nests. Reproductive males and females are produced in the late summer. Adults fly from at minimum June 1st to September 11th. Related species are known to have social organization in nests, but the social behaviour of the Sable Island Sweat Bee remains unstudied.

Population Sizes and Trends

The population size of Sable Island Sweat Bee is not possible to estimate given the collection data available for the species. Of the four bee species occurring on Sable Island, the Sable Island Sweat Bee is the least commonly collected. Historical records are too sparse to effectively estimate historical trends. Relative proportions of the two sweat bees on the island, *L. novascotiae* (Mitchell) to the Sable Island Sweat Bee, collected with nets in 1966 –1967, 2008, and 2013 are comparable (3:1, 1:1, 2:1, respectively).

Population sizes have likely decreased over historical time due to decreases in the spatial vegetated area on Sable Island.

Threats and Limiting Factors

Loss of habitat due to the inundation of vegetation by sand or submersion of low-lying areas with rising sea levels would have negative impacts on population sizes of the Sable Island Sweat Bee. Harsh weather conditions could compound this effect while also reducing adult foraging activity.

Past human influence may have also reduced the extent and diversity of flowering vegetation. Current human activity is minimal due to the isolation of the island and the control of visitors. There is potential with increased future human visitation to the island to introduce non-native bee species.

Protection, Status, and Ranks

The Sable Island Sweat Bee is not protected under federal or provincial legislation. The species has not been assigned a conservation status rank. The species' habitat is within Sable Island National Park Reserve, which is protected under the *Parks Canada Act*.

TECHNICAL SUMMARY

Lasioglossum sablense
Sable Island Sweat Bee — Halicte de l'île de Sable
Range of occurrence in Canada: Nova Scotia

Demographic Information

Generation time	1 year to complete life cycle
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? Historical data are too sparse for accurate estimate. Human influence and changing island geography suggest a long-term decline in suitable habitat and inferred decline in mature individuals.	Inferred.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] Historical data are too sparse for accurate estimate.	Unknown.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations]. Historical data are too sparse for accurate estimate. Human influence and changing island geography suggest a long-term decline in suitable habitat and inferred decline in mature individuals.	Inferred reduction.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations]. Historical data are too sparse for accurate estimate. Human influence and changing island geography suggest a long-term decline in suitable habitat.	Unknown.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. Historical data are too sparse for accurate estimate. Human influence and changing island geography suggest a long-term decline in suitable habitat and inferred decline in mature individuals.	Inferred reduction.
Are the causes of the decline clearly reversible and understood and ceased?	Not reversible; not fully understood; not ceased.
Are there extreme fluctuations in number of mature individuals? Based on life cycle patterns of related *Lasioglossum* bee species.	Not likely.

Extent and Occupancy Information

Estimated extent of occurrence (minimum convex polygon)	118 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	16 km²
Is the population severely fragmented?	No.
Number of locations	< 5

Is there an [observed, inferred, or projected] continuing decline in extent of occurrence? Projected habitat loss, extent and quality based on sand ecosystem erosion and sea level increases.	Yes.
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? Projected habitat loss, extent and quality based on sand ecosystem erosion and sea level increases.	Yes.
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No.
Is there an [observed, inferred, or projected] continuing decline in number of locations?	No.
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? Projected habitat loss, extent and quality based on sand ecosystem erosion and sea level increases.	Yes.
Are there extreme fluctuations in number of populations?	No.
Are there extreme fluctuations in number of locations?	No.
Are there extreme fluctuations in extent of occurrence?	No.
Are there extreme fluctuations in index of area of occupancy?	No.

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Total	Unknown.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not calculated

Threats (actual or imminent, to populations or habitats)

Possible habitat loss due to sand ecosystem erosion caused by wind, wave action, storms, feral horses and human foot traffic. Loss of habitat due to rising sea levels and flooding due to storms. Potential for introductions of non-native vegetation and additional non-native (to the island) species leading to competition.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	Endemic to Sable Island, no outside populations.
Is immigration known or possible?	Not applicable.
Would immigrants be adapted to survive in Canada?	Not applicable.
Is there sufficient habitat for immigrants in Canada?	Not applicable.
Is rescue from outside populations likely?	Not applicable.

Data-Sensitive Species

Is this a data-sensitive species?	No.

Status History:

Designated Threatened in November 2014.

Status and Reasons for Designation:

Current Status:	**Criteria:**
Threatened	D2
Reasons for Designation: This species is globally endemic to Sable Island, Nova Scotia, and occurs as one isolated population with a very small range and no possibility of rescue. The island has only about 13 km^2 of vegetated area that provides forage/nesting sites for this bee. Nesting likely occurs near or within this vegetated area and sweat bees are not known to travel large distances (i.e. > 200 m) for forage. Increased frequency and severity of storms, in addition to climate change and related sea level rise, are expected to drive change which will further decrease the quality and quantity of bee habitat on the island. Eco-tourism is also a potential future threat, which may also increase the introduction and spread of invasive species. Habitat on the island is also susceptible to invasive plant species, introduced horses, and seawater flooding.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Population trends unknown. Historical data is too few (or sparse) since the island has few historic and recent intensive collection events. This species was only described in 2010, and few bee (or insect) surveys have been conducted due to isolation.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. The EO is less than 5,000 km^2 (118 km^2) and the IAO is less than 500 km^2 (16 km^2), but it does not meet other components of the B criterion. There is some decline in habitat quality, but number of locations could not be determined.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Historical data are too sparse.
Criterion D (Very Small or Restricted Population): Meets Threatened D2 because the IAO is less than 20 km^2 and the species could become Endangered within a very short time period if there are extreme storm and flooding events.
Criterion E (Quantitative Analysis): Not applicable. Quantitative analysis has not been completed.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2014)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canadian Wildlife Service | Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

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Sable Island Sweat Bee
Lasioglossum sablense

in Canada

2014

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Hymenoptera
Superfamily	Apoidea
Family	Halictidae
Subfamily	Halictinae
Tribe	Halictini
Genus	*Lasioglossum* Curtis
Subgenus	*Dialictus* Robertson
Species	*Lasioglossum sablense* Gibbs

English Common Name: Sable Island Sweat Bee

French Common Name: Halicte de l'île de Sable, Lasioglosse de l'île de Sable

Taxonomic synonyms: None

Type specimens:

The type locality of the species is Sable Island, Nova Scotia, Canada. The holotype specimen is deposited at the Packer Collection at York University (PCYU), Toronto. Paratypes are deposited at PCYU and the Canadian National Collection of Insects, Arachnids, and Nematodes (CNC), Ottawa.

Taxonomic background and similarities:

Lasioglossum sablense Gibbs was first described in a revision of the subgenus *Lasioglossum* for Canada (Gibbs 2010). Sable Island Sweat Bee was first recorded by Wright (1989) as "*Lasioglossum* sp." [sic]. The original taxonomic description was based on 3 females and 5 males collected on the 8 August 2008 (PCYU) and 2 females and 2 males collected on the 11–15 September 1967 (CNC).

The Sable Island Sweat Bee is a member of the subfamily Halictinae and considered a 'sweat bee'; some species are known to visit humans to drink their perspiration. Sweat bees are a diverse, widely distributed group of bees. Approximately 170 described species of sweat bee occur in Canada. The genus *Lasioglossum* has over 1800 described species worldwide (Ascher and Pickering 2014) and is present within most terrestrial ecosystems that have a component of flowering plants (Michener 2007). *Lasioglossum sablense* is the only sweat bee with such a restricted distribution in Canada.

Morphological Description

The Sable Island Sweat Bee is a small, dull-metallic, sweat bee, approximately 5 to 6 mm in length. Females have pollen-collecting hairs on the hind legs and abdomen (Figure 1). Males are recognizable by their elongate antennae and slender abdomen (Figure 2). Both sexes have dense punctures on the dorsal surface of the thorax, adjacent to the wing bases. One other sweat bee, *L. novascotiae*, occurs on Sable Island, but can be distinguished by the sparse punctures on the dorsal surface of the thorax adjacent to the wing bases. The dense pale hairs on the end of the female's abdomen can be used to distinguish Sable Island Sweat Bee females from those of the more sparsely pubescent *L. novascotiae* (Mitchell), even with the naked eye. Identification keys for adult forms are provided in Gibbs (2010) and Gibbs (2011).

Immature forms of the Sable Island Sweat Bee have not been studied, but are expected to appear similar to other *Lasioglossum* species. Michener (1953) described the larvae of *Lasioglossum imitatum* (Smith) and several other sweat bee species.

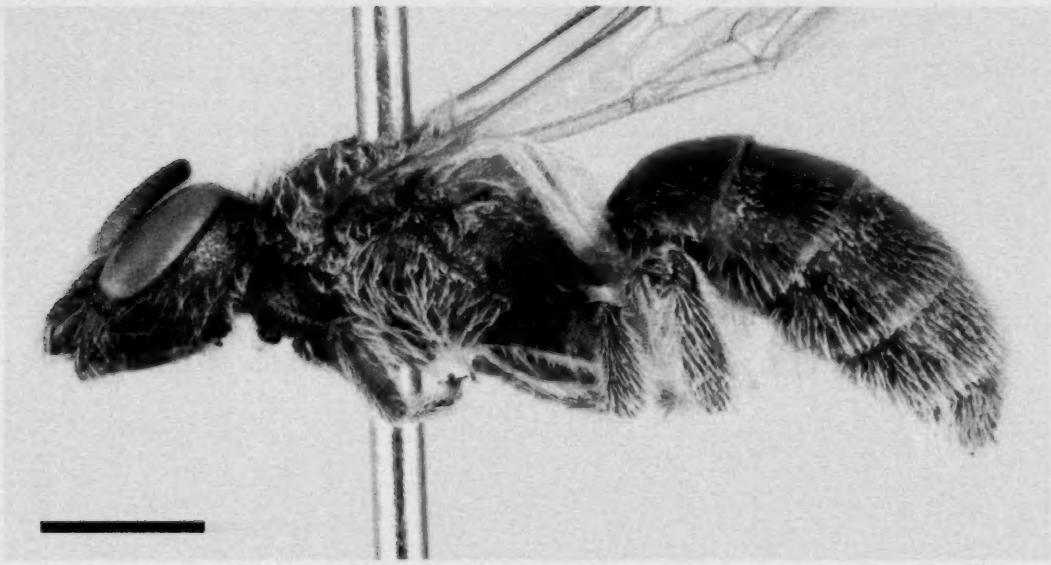

Figure 1. ***Lasioglossum sablense*** **female, lateral view (modified from Gibbs 2010). Specimen collected on 8 August 2008 and held at Packer Collection York University. Photograph taken by Jason Gibbs.**

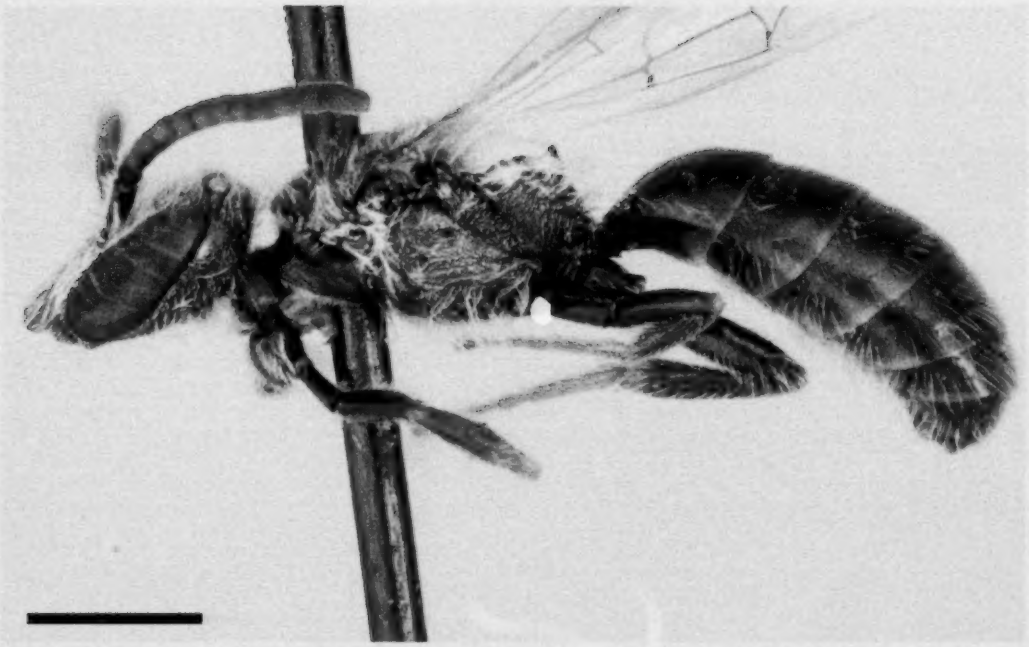

Figure 2. *Lasioglossum sablense* male, lateral view (modified from Gibbs 2010). Specimen collected on 8 August 2008 and held at Packer Collection York University. Photograph taken by Jason Gibbs.

Population Spatial Structure and Variability

The known range of the Sable Island Sweat Bee is limited to Sable Island, a small geographic area without physical barriers sufficient to prevent gene flow between flying insects. The small size of the island and the known flight range of other sweat bees (Batra 1984; Greenleaf *et al.* 2007) would easily allow for gene flow to occur across the species' range.

A short fragment (407 base pairs) of the mitochondrial gene cytochrome oxidase *c* subunit 1 was sequenced from five individuals of the Sable Island Sweat Bee (Gibbs unpublished data). There is evidence of allelic variation at two nucleotide positions. At one position this variation was only within individuals, suggesting heteroplasmy. This level of variation suggests a maximum genetic divergence of 0.25% within the population, but rigorous sampling has not been undertaken (Figure 3). P-distances from related species exceed 1%.

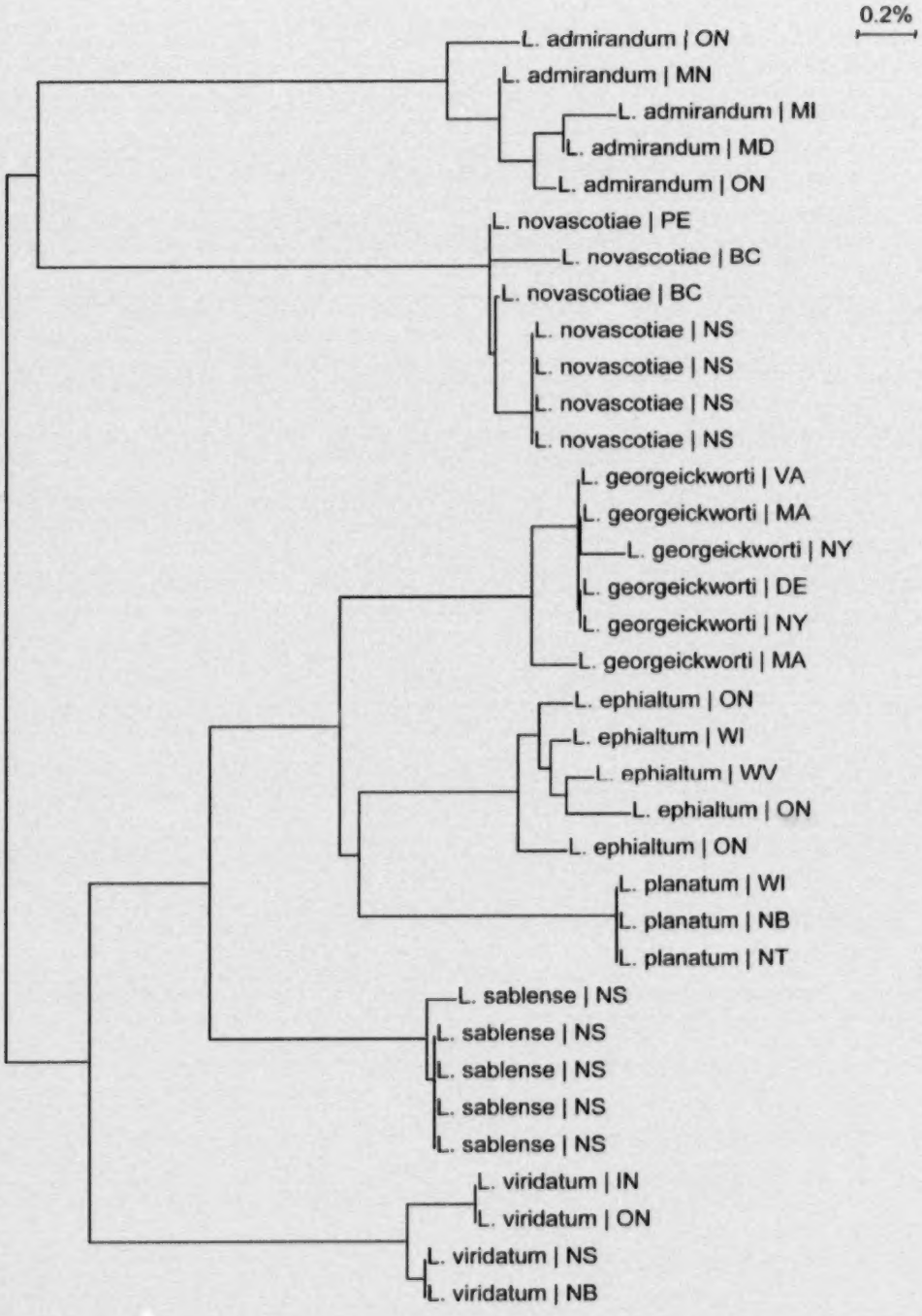

Figure 3. Neighbour-joining tree of cytochrome *c* oxidase subunit 1 sequences of *L. sablense* and related *Lasioglossum* species.

Designatable Units

The Sable Island Sweat Bee is being assessed as one designatable unit. There is no information on discreteness or evolutionary significance among populations, although this is unlikely given the small global range extent of this species. The species occurs within the Atlantic Ecological Area (COSEWIC 2011).

Special Significance

The Sable Island Sweat Bee is endemic to Canada, occurring solely on Sable Island, Nova Scotia. Three other bee species occur on the island: a sweat bee, *Lasioglossum novascotiae*, and two megachild bees, *Megachile melanophaea* Smith and *Osmia simillima* Smith. Only the Sable Island Sweat Bee is endemic to the island; the other three species are distributed across continental North America.

Sable Island is a unique ecosystem and includes several species or varieties of plants with restricted ranges (Catling *et al.* 1984). Some of these plants such as *Hieracium scabrum* (Michx.) var. *leucocaule* Fern. & St. John is visited by the Sable Island Sweat Bee. Pollination services by the Sable Island Sweat Bee and other bees on the island are likely crucial for the maintenance of these restricted plant populations on the island.

The bee is not known to have cultural significance to First Nations in the region. The first recorded humans to visit the island were Portuguese explorers in the 16th century. Human habitation over the next several centuries included the growing of vegetable crops and the exporting of wild cranberries. The Sable Island Sweat Bee would have contributed to the pollination of these crops.

DISTRIBUTION

Global and Canadian Range

The global and Canadian range of the Sable Island Sweat Bee is restricted to Sable Island, Nova Scotia, Canada (Figure 4 and 5).

Figure 4. North American map showing location of Sable Island, Nova Scotia.

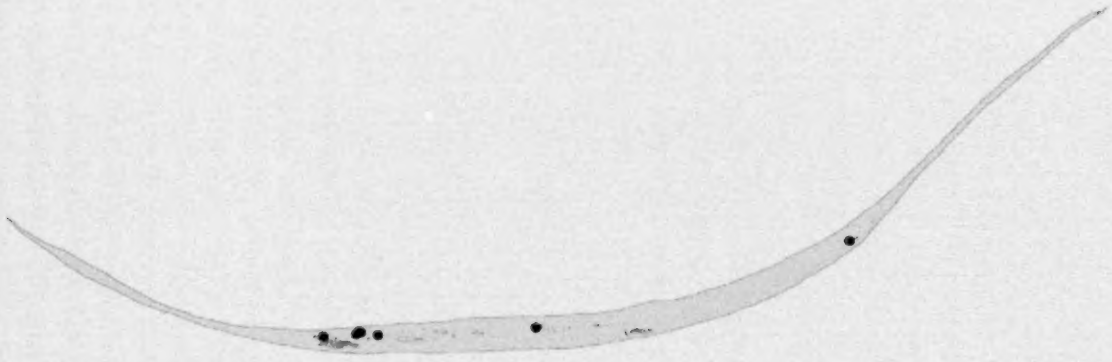

Figure 5. Map of Sable Island, Nova Scotia. Collection records of the Sable Island Sweat Bee are shown as black dots.

Extent of Occurrence and Area of Occupancy

Sable Island is approximately 34 km^2. Approximately 39% (13.26 km^2) of the island is vegetated (Catling *et al.* 1984), and the Sable Island Sweat Bee requires the flowering plants that occur in these vegetated areas for foraging. The foraging range for a bee of this size is likely a distance less than 1 km (Greenleaf *et al.* 2007). The windy conditions of Sable Island make it less likely that nesting areas are separated from vegetated areas. The biological area of occupancy for the Sable Island Sweat Bee is likely 13 – 15 km^2.

Extent of occurrence (EO) for the Sable Island Sweat Bee based on a minimum convex polygon is 118 km^2, most of this larger area is ocean and unsuitable habitat. An index of area of occupancy (IAO) using a grid of 2 km X 2 km squares is 16 km^2.

Search Effort

The Sable Island Sweat Bee is considered endemic to Sable Island based on the examination of thousands of specimens from Nova Scotia (e.g. Sheffield *et al.* 2013), New Brunswick, Prince Edward Island and Newfoundland, as well as other provinces and states, during the course of revisionary studies of Canadian and American *Lasioglossum* (Halictidae) (Gibbs 2010, 2011). Since completion of these taxonomic revisions, thousands of additional *Lasioglossum* specimens have been examined from these four provinces and no Sable Island Sweat Bees have been found outside Sable Island (Gibbs pers. data; Sheffield pers. comm. 2013). See Figure 6 for a compilation of recent search effort for *Lasioglossum* species.

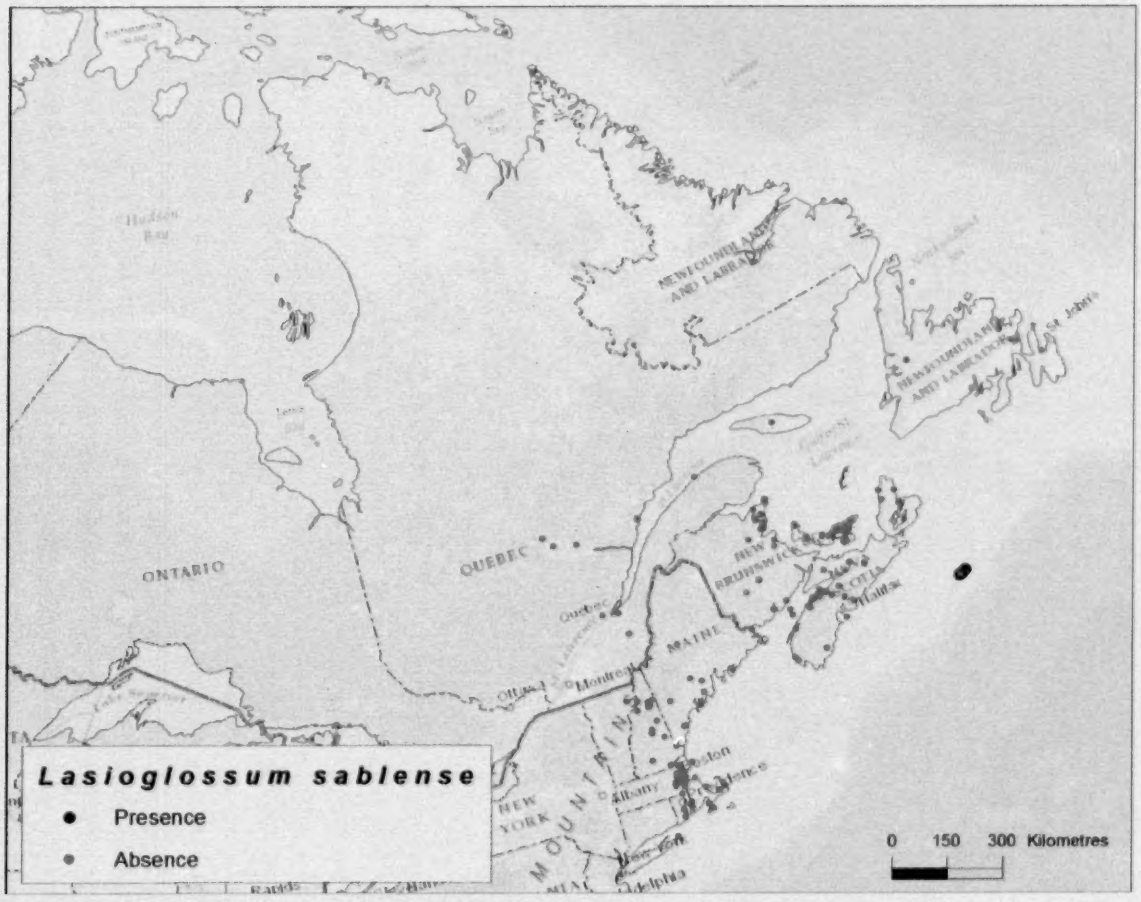

Figure 6. Search effort applicable to the Sable Island Sweat Bee (*Lasioglossum sablense*). Each red dot represents one collection locality from which *Lasioglossum* specimens have been examined within the past ten years (Gibbs 2010, 2011, pers. data.). The black dots are Sable Island Sweat Bee search effort and records.

The number of known specimens of the Sable Island Sweat Bee is very small due to limited sampling of bees on Sable Island. Additional specimens from field studies on Sable Island may be within unsorted samples housed in the Nova Scotia Museum (NSM, Halifax) and the CNC.

The Sable Island Sweat Bee specimens in the type series came from faunal surveys conducted in 1966 and 1967 (Howden *et al.* 1970) and 2008 (Catling *et al.* 2009). Approximately 800 specimens of unidentified *Lasioglossum* from Nova Scotia were identified from a recent loan of material from the CNC. A small proportion of these was from Sable Island and was composed of *L. novascotiae* (15 specimens) and the Sable Island Sweat Bee (5 specimens including the 4 CNC paratypes). These are the only two species of Halictidae confirmed for Sable Island (Catling *et al.* 2009; Gibbs 2010). Previous reports of *L. lineatulum* (Crawford) from Sable Island (Wright 1989) were probably misidentified specimens of *L. novascotiae*. Two additional species of bee, *Megachile melanophaea* and *Osmia simillima*, (both Megachilidae), are also known to occur on Sable Island (Wright 1989).

There are currently 106 bee specimens from Sable Island held at the NSM (Westby pers. comm. 2014). Six females (11-VIII-2011, 14-VIII-2011, 11-VII-2008, and 12-IX-1977) and 12 males (11-VIII-2011, 18-VIII-2008) of the Sable Island Sweat Bee were collected over the five collection dates. Few field observations accompany the specimens, including that some females were caught on cranberry (*Vaccinium macrocarpon* Aiton) and some males were caught within heath vegetation near a pond.

Bee collections in 2013 from Sable Island were completed using bowl traps and sweep netting. A total of 734 bees were collected; thirty-eight specimens were Sable Island Sweat Bees, including 19 females and 19 males. Search effort on Sable Island is summarized in Table 1.

Table 1. Summary of 2013 Sable Island bee collections. (Y = yellow bowl trap, P = pink bowl trap, B = blue bowl trap, G = green bowl trap).

General Survey Location	Date	*L. sablense* detected	Collection method	Search Effort	Collector
Sable Island West Light	01-Jun-2013	Yes	2Y,2P,2B,1G	13 hours	Rob Ronconi
Sable Island West Light	04-Jun-2013	No	1Y,1P,1B	4 hours, 25 minutes	Rob Ronconi
Sable Island West Light	05-Jun-2013	No	1Y,1P,1B, 1G	10 hours, 40 minutes	Rob Ronconi
Sable Island West Light	06-Jun-2013	Yes	1Y,1P,1B, 1G	13 hours, 45 minutes	Rob Ronconi
Sable Island East Light	10-Jun-2013	No	2Y,2P,2B,2G	8 hours, 5 minutes	Rob Ronconi
Sable Island West Light	13-Jun-2013	No	2Y,2P,2B,2G	11 hours, 15 minutes	Rob Ronconi
Sable Island West Light	15-Aug-2013	No	2Y,1P,2B,2G	11 hours, 5 minutes	Rob Ronconi
Sable Island West Light	16-Aug-2013	No	2Y,1P,2B,2G	5 hours, 15 minutes	Rob Ronconi

General Survey Location	Date	*L. sablense* detected	Collection method	Search Effort	Collector
Sable Island West Light	17-Aug-2013	No	2Y,1P,2B,2G	12 hours, 20 minutes	Rob Ronconi
Sable Island West Light	18-Aug-2013	Yes	2Y,1P,2B,2G	10 hours, 10 minutes	Rob Ronconi
Sable Island East Light	19-Aug-2013	Yes	2Y,1P,2B,2G	4 hours	Rob Ronconi
Sable Island Station	30-Jun-2013	Yes	Netting from *Rosa*	5 minutes	Zoe Lucas
Sable Island Station	30-Jun-2013	No	Netting from *Rosa*	5 minutes	Zoe Lucas
Sable Island Station	30-Jun-2013	No	Sweep netting	untimed	Zoe Lucas
Sable Island Station	30-Jun-2013	Yes	Sweep netting	10 minutes	Zoe Lucas
Sable Island Station	22-Jul-2013	No	Sweep netting	10 minutes	Zoe Lucas
Sable Island Station	22-Jul-2013	No	1Y	1 hour	Zoe Lucas
Sable Island Station	22-Jul-2013	No	1Y	1 hour	Zoe Lucas
Sable Island Station	22-Jul-2013	No	5Y	1 hour	Zoe Lucas
Sable Island Calopo Pond	25-Jul-2013	Yes	Sweep netting	3 minutes	Zoe Lucas
Sable Island Station	22-Jul-2013	No	1Y	1 hour	Zoe Lucas
Sable Island Station	25-Jul-2013	No	3Y	2 hours	Zoe Lucas
Sable Island Station	26-Jul-2013	No	5Y	3 hours 30 minutes	Zoe Lucas
Sable Island Station	26-Jul-2013	No	2Y	3 hours 15 minutes	Zoe Lucas
Sable Island Station	26-Jul-2013	No	1Y	3 hours 15 minutes	Zoe Lucas
Sable Island Station	26-Jul-2013	No	1Y	3 hours	Zoe Lucas
Sable Island Station	30-Jul-2013	Yes	Sweep netting	1 hour	Zoe Lucas
Sable Island Station	30-Jul-2013	No	Netting *Hieracium*	1 hour	Zoe Lucas
Sable Island Station	30-Jul-2013	Yes	Netting *Hieracium*	1 hour	Zoe Lucas
Sable Island Station	30-Jul-2013	No	9Y	4 hours	Zoe Lucas
Sable Island Station	17-Aug-2013	No	Netting *Rosa*	10 minutes	Zoe Lucas

HABITAT

Habitat Requirements

The Sable Island Sweat Bee is a ground-nesting bee with a likely nesting preference for sandy soils. Several mainland species of *Lasioglossum* are also limited to sand dune habitats (Gibbs 2010, 2011). Soils on the island have low organic matter content (Catling *et al.* 1984), which further supports the importance of sand as a nesting substrate. Vegetated areas are composed of a few distinct plant communities the largest of which are Marram-Forb grasslands, sparse grasslands and heath.

Sable Island Sweat Bees are present throughout most of the growing season, and thus foraging adults require a variety of floral resources from spring to fall. Females are active from at least June 1st to September 11th. Floral records come from six genera in five families - Asteraceae: *Achillea* (yarrow), *Hieracium* (hawkweed), Ericaceae: *Vaccinium* (blueberries, cranberries), Onagraceae: *Oenothera* (evening primrose), Polygonaceae: *Polygonum* (knotweed), and Rosaceae: *Rosa* (wild rose), demonstrating the species is polylectic (Gibbs 2010). Related species in the subgenus *Lasioglossum* have similar habitat requirements. A habitat photograph is shown in Figure 7.

Figure 7. A collection site of the Sable Island Sweat Bee, *Lasioglossum sablense*, near the Sable Island Station. Photograph taken July 2013 by Zoe Lucas.

Habitat Trends

Sable Island is estimated to be 14 to 16 thousand years old (King 2001). Over geological time, the island may have once been part of larger glacial refugia during the Wisconsinan ice age, when sea levels were 120 m lower than present (King and Fader 1986). The island is a constantly shifting sand bar, which is being gradually lost and rebuilt over time by waves. At present, Sable Island is part of a larger submerged sand mass near the edge of the continental shelf (Cameron 1965).

Sable Island does not appear to have decreased in size over the past few hundred years, although the shape and area of vegetation available to the bee may have changed. Cameron (1965) completed historical mapping and concluded the island is not overall rapidly eroding. Blowing winds and wave action cause the reduction in size in the western part of the island and build up on the eastern edge (Cameron 1965). Taylor (1982) notes the role of offshore, submarine sand bars in stabilizing the corresponding shoreline of the island. Apparently, more sand transport and instability occurs where such sand bars erode or are absent. Scott *et al.* (1984) found that while sea level has been rising steadily for the last 10,000 years, Sable Island has been stable over the past 7,500 years, continually aggrading as the sea rose. While the complete sinking of the island is not out of the question, Sable Island appears to also be rising, and this would prolong such a sinking event.

More recently Environment Canada (1998) summarized the above and more recent information, the island stability, and the long-term picture of dynamic weather including storms, erosion and accretion, impacts to vegetation and the conservation of the island.

With respect to Sable Island Sweat Bee, the extent and area of vegetation that provides the floral resources and nest sites for the species, and the habitat trends for these areas, are the key factors to its survival. There are challenges to assessing vegetative changes on Sable Island. In extreme winds, vegetated portions of dunes can become destroyed thus forming large blowouts (Cameron 1965). Freeman (1996) concluded there was little vegetation change between 1963, 1972, and 1981. However, in more recent years the spatial area may be changing and the extent of vegetated terrain may be decreasing as moving sand covers vegetation (Catling *et al.* 1984; Catling pers. comm. 2014).

Rising sea levels could shrink the island, and it is believed that this decrease would also result in a loss of vegetated area, which would have had a strong negative effect on populations of Sable Island Sweat Bee. For example, Lake Wallace, an inland lake on the south side of the island, has experienced numerous breaches of the dunes protecting the lake and subsequent influx of ocean water during storms (Environment Canada 1998).

Additional long-term decline in habitat quality has been ongoing since non-native horses were introduced to the island in the mid-1700s. The threats to the ecosystem from horses are discussed in the Threats section (IUCN Threat 8).

BIOLOGY

The Sable Island Sweat Bee belongs to a cosmopolitan (occurring on all continents except Antarctica) genus. Canadian members of the subgenus *Lasioglossum* were revised by Gibbs (2010). Species in this subgenus are predominately ground-nesting and form primitively eusocial colonies (annual colonies with reproductive division of labour) (Michener 1974; Gibbs *et al.* 2012). There are some exceptions (species that do not form annual colonies) in this genus, which are solitary or communal species (Michener 1974; Packer 1994; Yanega 1997). Some species in this genus are wood-nesting (Stockhammer 1967; Gibbs 2011) although the lack of trees on Sable Island precludes the Sable Island Sweat Bee as a wood-nester.

Life Cycle and Reproduction

Lasioglossum are often primitively eusocial bees that form small colonies; however, the colonial nature of this genus is different from that of bees such as bumble bees or honey bees. Some *Lasioglossum* are solitary and some live communally in groups, although this may partially be attributed to suitable nest sites within a given area.

In temperate regions *Lasioglossum* typically have an annual life cycle (Michener 1974). Inseminated females overwinter and emerge in spring to initiate new nests. In eusocial colonies the first brood is composed of non-reproductive females (workers). The overwintering female becomes a queen and is primarily responsible for reproduction of the colony. Reproductive males and females are produced later in the summer. In solitary species there is no non-reproductive worker brood.

There are four life stages: egg, larva, pupa and adult. Adult females of *Lasioglossum* form simple underground burrows with lateral cells (Sakagami and Michener 1962). Females provision cells with a mixture of nectar and pollen, which are formed into a ball-shape. Nest construction and foraging activities are taken over by workers in eusocial colonies. A single egg is placed in each cell. Eggs hatch and the developing larvae feed on the nectar and pollen mass, which will be the total food provided to the immature bee. Developmental time from egg to adult is typically 3-4 weeks, developing through 5 larval instars and 1-2 weeks spent as pupae (Yanega 1997; Michener 2007). During pupation the larvae undergo complete metamorphosis.

Formation of eusocial colonies is likely the ancestral state for *Lasioglossum* (Danforth *et al.* 2003; Gibbs *et al.* 2012). The nesting biology of the Sable Island Sweat Bee has not been studied, but it could possibly be social based on phylogenetic relationships. Colony sizes are typically small and range from 2-84 females at maximum size depending on species and colony (Michener 1974). The cool weather conditions on Sable Island likely preclude the formation of large colony sizes. Some halictid bees are socially polymorphic, reverting to solitary behaviour when climatic conditions are poor (Packer 1990; Field *et al.* 2010). Further study of the nesting biology is needed to determine its social status and what proportion of females collected on flowers are reproductive.

Physiology and Adaptability

Flight activity of foraging bees is greatest in warm (> 20°C), sunny weather with low winds (Tuell and Isaacs 2010). There is no information on the minimum flight temperature for the Sable Island Sweat Bee. However, studies on *Lasioglossum ruidosensis* in Alaska indicate that these sweat bees could fly only when the environmental temperature (not precisely the same as ambient temperature) reached 17.5°C. In general, this species and other small sweat bees studied were considered poor thermoregulators (Bishop and Armbruster 1999). Suboptimal temperatures reduce foraging activity and potentially productivity. Females return to nests at night and are protected from inclement weather. Male bees typically sleep outside and are capable of surviving nighttime temperatures.

Bees of the genus *Lasioglossum* occupy a wide range of climatic regions. The Sable Island Sweat Bee probably has similar adaptations to other temperate or boreal zone *Lasioglossum*. Sable Island has relatively cool summers for southern Canada (Table 2). Climate data from 1971–2000 records show mean maximum temperatures in June (18.4°C), July (20.6°C) and August (18.4°C) (Table 2). These low average temperatures could limit bee foraging activity. Winter weather is relatively mild on Sable Island relative to other regions of Canada (except areas of the Pacific coast).

The Sable Island Sweat Bee appears to be a floral generalist, based on the collection of specimens foraging from six genera in five plant families. This variety of floral resources suggests the Sable Island Sweat Bee is flexible in its pollen and nectar requirements. Many *Lasioglossum* show similar floral generalization, and have been recorded visiting more than two dozen plant families (Gibbs 2010).

Table 2. Weather data for Sable Island (1971 – 2000) (climate.weather.gc.ca).

Variable	April	May	June	July	August	September	October
Average Temperature (°C)	3.8	7.2	11.2	15.7	17.8	15.7	11.4
Maximum Temperature (°C)	6.2	9.8	14	18.4	20.6	18.4	14.1
Minimum Temperature (°C)	1.2	4.6	8.4	12.9	14.9	12.9	8.8
Extreme Maximum Temperature (°C)	13.9	17.8	21.7	29.6	27.8	27	22.8
Days with Extreme Minimum Temperature (°C)	-8.9	-8.3	0.6	3	4.4	0.6	-1.2
Days with temperatures above 0°C	30	31	30	31	31	30	31
Days with temperatures above 10°C	2.2	14.6	28.3	31	31	30	27.6
Days with temperatures above 20°C	0	0	0.17	6.3	18.6	6.9	0.2
Days with temperatures above 30°C	0	0	0	0	0	0	0
Average wind speed (km/h)	26.2	21.8	19.8	17.9	17.5	21.2	25.8

Dispersal and Migration

There is little information on natural dispersal rates for *Lasioglossum* bees. The Sable Island Sweat Bee likely has limited dispersal capabilities. These are flying insects, but typical flight distances for bees of this size are probably less than 1 km (Greenleaf *et al.* 2007). Some sweat bees are known to return to natal nesting areas in spring, which limits dispersal rates (Yanega 1990). Dispersal from Sable Island to the nearest mainland would require abiotic factors (e.g. wind) to travel the greater distance (> 150 km). The most frequent wind direction during adult life stages of the bee is from the southwest. This would blow in the direction of Newfoundland, a distance of approximately 400 km. Ground-nesting of the Sable Island Sweat Bee makes human-mediated dispersal unlikely. Most bees transported by humans are cavity-nesting species (Cane 2003).

Interspecific Interactions

The Sable Island Sweat Bee is dependent on the pollen and nectar resources of numerous flowering plants found on Sable Island. The long phenology of *Lasioglossum* colonies requires the use of multiple flowering species. No individual plant is likely to be an obligate requirement for the Sable Island Sweat Bee, but a diverse flowering community is necessary to maintain populations of the bee. Even with limited net collections, floral visitation records come from six genera in five families (Asteraceae: *Achillea*, *Hieracium*, Ericaceae: *Vaccinium*, Onagraceae: *Oenothera*, Polygonaceae: *Polygonum*, Rosaceae: *Rosa*). *Lasioglossum* species are regularly collected from other plant families (Gibbs 2010), including the following families, which are known from the island: Apiaceae, Brassicaceae, Fabaceae, Lamiceae, and Ranunculaceae (Catling *et al.* 1986). A list of the Sable Island vegetation is available in Catling *et al.* (1986).

In spring, the bee fauna is predominately composed of the two *Lasioglossum* species, the Sable Island Sweat Bee and *L. novascotiae*, with lower numbers of two megachilid bees. *Osmia simillima* is the first megachilid bee to emerge. It declines in abundance as spring progresses, becoming uncommon during the early summer and is absent later in the year. *Megachile melanophaea* first occurs in spring, but does not occur in abundance until summer.

Although there is potential for competition for floral resources among other bees, the generalist nature of the Sable Island Sweat Bee allows for the possibility of some niche partitioning.

POPULATION SIZES AND TRENDS

There is no information on population sizes and trends for the Sable Island Sweat Bee. To date, surveys have been opportunistic collection events during visits to the island by biologists studying other natural history questions. Historical specimens of the Sable Island Sweat Bee were made from sweep netting vegetation as part of general collections (Wright 1989; Catling *et al.* 2009).

Sampling Effort and Methods

Specimens collected during 2013 surveys used standardized bowl trapping and hand netting. Bowl trapping bees is a passive collection method that involves the use of coloured bowls (Droege *et al.* 2010). Although bowl trapping can give a biased perspective of bee community (Cane *et al.* 2000), it is known to collect *Lasioglossum* in high numbers (Droege *et al.* 2010). Bees were collected on Sable Island using coloured bowl traps (blue, pink, yellow and green) filled with dish soap water. Traps were deployed at two sites, the west (43.93208, -60.02316) and east (43.95876, -59.78298) end lighthouses, on opposite ends of the island. Collections were made during June and August, 2013 (Table 1).

Both the east and west end sampling sites near the lighthouses were sparse grassy areas with sandy soil. Flowering plants at these sites were primarily Sorrel (*Rumex spp.*), Wild Strawberry (*Fragaria spp.*) and Large False Solomon's Seal (*Maianthemum racemosum*) during June and Yarrow (*Achillea*), Pearly Everlasting (*Anaphalis margaritacea*) and Smooth Hawksbeard (*Crepis capillaris*) during August.

Additional collections, primarily near the Sable Island Station (Figure 7) in late June and August (Table 1) were completed using an insect net and yellow bowl traps. Net collections included focused, timed sampling from Rugosa Rose (*Rosa rugosa*) and *Hieracium* sp. Sweep net samples from vegetation and bowl trap samples were in areas dominated by either clover (Fabaceae) or areas which included blooming individuals of Cranberry (Ericaceae), Tuberous Grass-pink (*Calopogon* sp.), Yellow Loosestrife (*Lysimachia spp.*) and/or Northern Bayberry *Myrica spp.* Most net collections were made for brief (5 – 10 min.) periods. Floral records of the Sable Island Sweat Bee were made from Rugosa Rose and *Hieracium*, which add another genus and another plant family to the known associations of the species. More than two thirds of the Sable Island Sweat Bee specimens netted from vegetation were found on *Hieracium* sp. Yellow bowl traps placed in areas with an abundance of *Hieracium* did not collect specimens of the Sable Island Sweat Bee, and in areas and times where *Megachile melanophaea* was collected or observed in great abundance, the Sable Island Sweat Bee was infrequently collected.

Abundance

There are four bee species recorded from Sable Island and the Sable Island Sweat Bee is the least abundant bee recorded during surveys. In bowl traps *M. melanophaea* (304 individuals) is the most commonly collected (337 individuals) followed by *L. novascotiae* (277 individuals), then *O. simillima* (10 individuals) and the Sable Island Sweat Bee (5 individuals). However, Sable Island Sweat Bees may not be well sampled by bowl-trapping. The large difference in the numbers of the two *Lasioglossum* species found in the bowl traps (ratio of 55:1) is not paralleled in the net captures of *L. novascotiae* (64 individuals) and the Sable Island Sweat Bee (33 individuals) (ratio approximately 2:1). Net collections of historical specimens at the CNC of these two *Lasioglossum* found a similar ratio (3:1). Although sample sizes are small, these data suggest a stable proportion of these two species.

Fluctuations and Trends

Results from sweep netting show comparable proportions of the two *Lasioglossum* species on the island. Twenty specimens of *Lasioglossum* collected from Sable Island in 1966 and 1967 were examined and found to be in a ratio of 3:1 (15 *L. novascotiae* and 5 Sable Island Sweat Bees). Seventeen specimens of *Lasioglossum* collected in 2008 were found to be in nearly equal proportions of the two species (8 Sable Island Sweat Bees and 9 *L. novascotiae*). Net collections made in 2013 found a similar proportion of individuals of these two species (2:1).

Comparison of the historical collections to bowl trap numbers gives a dramatically different picture because *L. novascotiae* is collected 55 times more frequently than the Sable Island Sweat Bee in bowls.

The low number of historical specimens of the Sable Island Sweat Bee makes it difficult to determine if the populations have changed over time. Habitat changes caused by anthropogenic actions (e.g., historical farming) and natural processes have influenced habitat availability, and the likely drivers for population fluctuations (see Habitat Trends and Threats).

Rescue Effect

The Sable Island Sweat Bee is endemic to Sable Island and rescue effect is not possible.

THREATS AND LIMITING FACTORS

The International Union for Conservation of Nature-Conservation Measures Partnership (2006) (IUCN-CMP) threats calculator was used to classify and list threats to the Sable Island Sweat Bee (Salafsky *et al.* 2008; Master *et al.* 2009).

Most threats to the Sable Island Sweat Bee are negligible (explained in Table 3), except for low threats from invasive and other problematic native species and from climate change and severe weather. Non-native horses on the island can cause substantial damage to the integrity of the bee's habitat by increasing erosion and decreasing available forage plants. Increasing populations of native gray seals, which spend time on the island, could also have an impact on the bee. There are medium to low threats from periodic storms and flooding, which inundate the island, damaging the bee's habitat. Multiple sites on the island are at risk of being breached by sea levels, which could have a significant impact on the structure of the vegetated surface and the bee's habitat. Future eco-tourism may pose a future threat to bee habitat.

The threats below are discussed according to the IUCN-CMP threat classification number and are considered equally applicable. The overall Threat Impact for the Sable Island Sweat Bee is low (Table 3).

Table 3. Threats assessment for Sable Island Sweat Bee based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. For a detailed description of the threat classification system see the CMP website (CMP 2010) and Master *et al.* (2009).

Species Name	Sable Island Sweat Bee, *Lasioglossum sablense*			
Date	2014-01-22; updated 2014-08-22			
Assessor(s):	Jason Gibbs (status report author), Paul Catling (Agriculture and Agri-Food Canada), Heather Stewart (Parks Canada Agency), Cory Sheffield (Royal Saskatchewan Museum), Ruben Boles (Canadian Wildlife Service), Syd Cannings (Canadian Wildlife Service), Julie McKnight (Canadian Wildlife Service), Mary Sabine (New Brunswick), Bill Freedman (Dalhousie University), Jennifer Heron (Arthropods SSC Co-chair).			
			Level 1 Threat Impact Counts	
	Threat Impact		**high range**	**low range**
	A	Very High	0	0
	B	High	0	0
	C	Medium	0	0
	D	Low	2	2
		Calculated Overall Threat Impact:	Low	Low

	Threat	**Impact (calculated)**	**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development	Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, < 10 yrs)	There is a large footprint of existing buildings currently on the island; however, most of these are abandoned and in various stages of collapse and decay. Parks Canada plans to take inventory of these buildings and, in time, decommission those deemed to be a safety hazard (Stewart pers. comm. 2014). Soil compaction and trampling of floral resources and nest sites may impact the bee during decommissioning, if and when this occurs.
1.1	Housing & urban areas	Negligible	Negligible (<1%)	Negligible (<1%)	Low (Possibly in the long term, >10 yrs)	There aren't many buildings in use for housing on the island. Currently not applicable, this is considered a historic or past threat. Historically, small communities of people have lived on the island, but there is currently limited housing on the island.
1.2	Commercial & industrial areas	Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, < 10 yrs)	There are several buildings on the island, which are used to store maintenance and research equipment and supplies, including fuel. Future development is unlikely given the island's protection as a national park; however, future decommissioning of existing buildings or their replacement and/or upgrades with new structures could lead to increased disturbance in the vicinity of the structures. There are likely to be upgrading and construction of maintenance buildings on the island and the footprint will likely expand within the next ten years (Stewart pers. comm. 2014).

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.3	Tourism & recreation areas	Negligible	Negligible (<1%)	Slight (1-10%)	Low (Possibly in the long term, >10 yrs)	Sable Island was established as a National Park Reserve in June 2013. Until the development of a management plan for the Sable Island National Park Reserve, it is difficult to predict how expected increases in tourism will affect the bee and its habitat. It is not expected that there will be substantial infrastructure development to facilitate tourism. Marina and boat launch facilities are not likely to be constructed due to the shifting sands and soft substrate on the island. It is unlikely camping facilities or overnight housing for tourists will be constructed.
2	Agriculture & aquaculture	Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/ Negligible (Past or no direct effect)	
2.1	Annual & perennial non-timber crops	Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/ Negligible (Past or no direct effect)	Currently not applicable, this is considered a historic or past threat. It is likely that habitat changes on the island from anthropogenic disturbance since the 1500s have had a negative impact on Sable Island Sweat Bee nesting and foraging habitat. Historically, large areas of vegetated habitat on the island were lost during periods of intensive agriculture (see Catling *et al.* 1984).
2.2	Wood & pulp plantations					Not applicable.
2.3	Livestock farming & ranching	Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/ Negligible (Past or no direct effect)	Currently not applicable and considered a historic threat. Various livestock including cattle, horses and pigs, were introduced at various times during human settlement on Sable Island. Today, only feral horses remain on the island. The presence of feral horses on the island likely increases erosion and reduces floral diversity through trampling, soil compaction, urination and defecation. These cumulative effects likely impact bee foraging sites and nesting sites and ultimately negatively impact bee populations. The horses are considered naturalized; they are not fed or cared for nor is there any other form of intervention in population management. It is possible there may be some stewardship measures considered in the future, but at present there are none. This threat is categorized under Threat 8.1.
2.4	Marine & freshwater aquaculture					Not applicable.
3	Energy production & mining	Not a Threat (in the assessed timeframe)	Small (1-10%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.1	Oil & gas drilling	Not a Threat (in the assessed timeframe)	Small (1-10%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	The Sable Offshore Energy Project includes a central processing facility near Sable Island. Current regulations prevent oil or gas drilling within one nautical mile of Sable Island. The current nearest drilling facility is 12 km from the island. Drilling facilities occur to the east, south and west of the island (Lucas *et al.* 2012). The Offshore Accord Implementation Act takes precedent over the *Canada National Parks Act* so future energy production on or near the island is possible. Subsurface horizontal drilling beneath the island is permitted although not currently underway. It is unclear what effect subsurface drilling would have on the island, but any disturbance or collapse of material beneath the island could be devastating if it causes the low-lying island to sink. A catastrophic release of liquid gas from a nearby oil facility could potentially damage the island's ecosystem. Local ocean currents result in a counterclockwise gyre, which occasionally deposits floating material, including oil or oil-contaminated objects on Sable Island (Hannah *et al.* 2001; Lucas *et al.* 2012). The frequency of oil contaminated birds reaching the island has decreased in recent years, which may be a product of increased regulation and enforcement (Lucas *et al.* 2012). These floating objects may act as attractants to bees, but there are no studies to confirm if Sable Island Sweat Bee lands on these objects.
3.2	Mining & quarrying					Not applicable.
3.3	Renewable energy	Not a Threat	Negligible (<1%)	Neutral or Potential Benefit	Insignificant/ Negligible (Past or no direct effect)	There is small-scale solar and wind energy generation on the island for local use only. Although there may be replacement of equipment in the future, it is not expected the footprint of these structures will increase in the future.
4	Transportation & service corridors	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
4.1	Roads & railroads	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Vehicular transport on the island is limited to park administration and researchers. There are currently 33 vehicles on the island, including but not limited to: all-terrain vehicles, service vehicles for plane traffic, a truck, and a tractor. Vehicle traffic is restricted to barren beaches, limited roads near the island station and other predefined routes on the island. Designated vehicle traffic areas on the island are not severely compacted and are not likely to impact bee nesting. Driving on vegetation and dune slopes is prohibited, which should limit direct impact on floral hosts and nesting sites of Sable Island Sweat Bee. This threat is considered negligible.
4.2	Utility & service lines	Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, < 10 yrs)	There are existing electrical communication lines running underground on the island. Some of these cables and lines are linked to live lines and may be active. Future hazard and electrical activity assessments are planned. If deemed a physical or electrical safety hazard, then these lines will be removed. Removal would likely result in minimal invasive methods and involve small-scale digging with small machinery or by hand. This could have small impacts on bee nests, but is not considered a significant threat.

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
4.3	Shipping lanes	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Passing ships could lead to oil discharge, which due to ocean currents could reach the island in small amounts. The occurrence of oil slicks or tar particles reaching the island is infrequent and was not recorded during a four-year survey from 2006 to 2009 (Lucas *et al.* 2012).
4.4	Flight paths					Not applicable.
5	Biological resource use	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	This is limited to permitted research activities on the island. General insect collections on the island could potentially impact the population size if too many specimens are taken. To date the total number of Sable Island Sweat Bee collected is quite low, but future insect collections particularly using passive sampling methods such as bowl traps and Malaise traps could potentially kill large numbers of individuals in a short period. Malaise trap-use is limited to certain fenced areas to protect feral horses. Illegal insect or flower collections by visitors on the island would negatively impact Sable Island Sweat Bee, but these activities should be minimized by the limited traffic on the island. Bycatch from other research activities (non-entomologically related) would also consider impacts to the bee and its habitat.
5.2	Gathering terrestrial plants					Not applicable.
5.3	Logging & wood harvesting					Not applicable.
5.4	Fishing & harvesting aquatic resources					Not applicable.
6	Human intrusions & disturbance	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Sable Island is protected under the *Canada National Parks Act*. Direct human impacts on the island are limited by its national park status (see Habitat Protection and Ownership) and its isolation from the mainland. Sable Island has a limited number of regular occupants and research activities. It is occasionally visited by tourists, either by chartered flight or cruise ship. Many activities are prohibited on the island, but human foot traffic can potentially increase erosion on dune slopes and vegetated areas and ultimately damage sensitive bee habitat. It is expected that tourism on the island will increase with its establishment as a National Park. There are plans for tourist cruise ships to visit the island. Each ship could bring 100 or more visitors to the island, which represents an increase over recent tourism. Visitors are monitored and given an orientation to the island by park staff, which should further limit impacts of increased tourism. Increased visitation will increase the probability of introduction of invasive species.
6.2	War, civil unrest & military exercises					Not Applicable.

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.3	Work & other activities	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	There may be limited impact resulting from research activities on the island related to vehicle travel and transects for monitoring wildlife. By-catch of bees as part of non-specific trapping methods could occur. These are considered minor or insignificant threats to the bee.
7	Natural system modifications	Negligible	Negligible (<1%)	Negligible (<1%)	Low (Possibly in the long term, >10 yrs)	
7.1	Fire & fire suppression	Negligible	Negligible (<1%)	Negligible (<1%)	Insignificant/ Negligible (Past or no direct effect)	Fire is not a component of the island's natural ecosystem. There are no fire suppression activities. There is a minor threat of accidental fire near buildings, but this is unlikely to impact the bees or their host vegetation.
7.2	Dams & water management/use					There is not yet a management plan developed for the park. Some water is drawn for use in structures and waste water is released into a septic system (see Threat 9.1). There may be some future assessment of waste water, but it is not expected to impact bees.
7.3	Other ecosystem modifications	Negligible	Negligible (<1%)	Negligible (<1%)	Low (Possibly in the long term, >10 yrs)	There are likely to be future plans and recommendations for ecosystem restoration or enhancement on the island. These may include modifications of existing vehicle routes to decrease erosion, by making these routes sinuous rather than the current straight-line routes. In general, these ecosystem modifications are not likely to impact bees, and modifications that prevent erosion of vegetated areas may benefit Sable Island Sweat Bee habitat.
8	Invasive & other problematic species & genes	Low	Pervasive - Restricted (11-100%)	Slight (1-10%)	High (Continuing)	
8.1	Invasive non-native/alien species	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Sable Island has a resident population of naturalized horses. The original source population of these horses is unknown; however, horses have been on the island for at least 500 years. The impact of the feral horse population on Sable Island Sweat Bee is unclear and requires additional study. Trampling of vegetation or nest sites by the horses is potentially damaging either directly or through increased erosion (Freedman *et al.* 2011). Horses preferentially consume Marram grass (*Ammophila breviligulata*), which is the primary plant sand-binding species responsible for preventing erosion. This large herbivore has the potential to also consume valuable floral hosts of the bee. However, feral horses may also help structure the sand ecosystem, allowing forbs to compete with grasses on the island and enable the open sand ecosystems to remain as such. Since the bees and most plants likely preceded the presence of the horses by several thousand years this possible benefit may not be required. Population sizes vary from 150 to 400 to horses (Lucas *et al.* 1991) so there may significant year-to-year variation in the impact of the horses. Recent estimates put the horse population near its maximum (Lucas *et al.* 2009). Additional research on the effect of horses on Sable Island Sweat Bee and its floral hosts using horse enclosures are needed (Freedman *et al.* 2011).

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
						If other bees were introduced to the island then they could potentially impact Sable Island Sweat Bee through competition or introduced disease. In the past, bees have been intentionally and unintentionally transported during human activities, but this has primarily been cavity-nesting species (Cane 2003). Nest sites for cavity-nesting bees would be limited to areas near buildings or other structures, which would minimize the impact and likelihood of establishment of these bees. Transportation of ground-nesting species is unlikely since it would require movement of large amounts of soil. The broad floral host range of Sable Island Sweat Bee also may help it escape competition from other species. Other invasive insects, such as ants or bee-attacking insects, could potentially impact Sable Island Sweat Bee. Additional surveys of the insect fauna to monitor any changes are needed. The last extensive faunal list for Sable Island was published by Wright (1989), and much of this was based on earlier literature (e.g. Howden *et al.* 1970). Introduction of an invasive plant species to the island could be problematic to Sable Island Sweat Bee and its habitat. These could be transported through numerous pathways, including seeds being moved in clothing and shoes of tourists. The harsh conditions of the island (e.g. cool summer climate, high sand content, and heavy inundation of salt water) is likely to limit the number of invasive species that could successfully establish themselves on the island. Nevertheless, any invasive plant that interferes with the natural ecosystem of the island could be potentially harmful to Sable Island Sweat Bee. Some of the plant species on the island are non-native (Catling *et al.* 1984) and some such as *Calluna vulgaris* (L.) (ERICACEAE) Hull may be increasing in population size.
8.2	Problematic native species	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	Grey seals (*Halichoerus grypus*) on the island have the potential to damage vegetated areas during the winter months when they come inland. Grey seal populations increased exponentially over several decades during the late 20th century (Bowen *et al.* 2003), although this population growth has declined (Bowen *et al.* 2007). During winter months, the seals move inland and occupy the lowland terrestrial areas of the island, although it is unknown how this impacts the bee overwintering sites and dormant floral resources.
8.3	Introduced genetic material					Not applicable.
9	Pollution	Negligible	Small (1-10%)	Unknown	High (Continuing)	
9.1	Household sewage & urban waste water	Not a Threat	Negligible (<1%)	Neutral or Potential Benefit	High (Continuing)	There are septic systems in place on the island for waste water and sewage. These are unlikely to directly impact Sable Island Sweat Bee.
9.2	Industrial & military effluents		Small (1-10%)	Unknown	High (Continuing)	There may be potential impacts from shipping lanes and offshore oil rigging (see above.)

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.3	Agricultural & forestry effluents	Not a Threat (in the assessed timeframe)	Unknown	Unknown	Insignificant/ Negligible (Past or no direct effect)	These are prohibited due to the island's status as a national park. Historical use of chemicals is uncertain.
9.4	Garbage & solid waste	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	There is garbage from past human habitation on the island. Garbage includes oil drums, containers, and structural remains from buildings, farming equipment, and other unknown materials. Most garbage is inert and unlikely to impact bee populations. Some chemical leaching occurs, including mercury from old light bulbs, in the vicinity of the lighthouses and oil from various sources (see above). These likely impact the sand ecosystem in the vicinity of leaching and may have minor impacts on Sable Island Sweat Bee.
9.5	Air-borne pollutants					There are occasional aerosol pollutants, which reach the island from offshore drilling facilities. The impact of these is uncertain.
9.6	Excess energy					Not applicable.
10	Geological events		Small (1-10%)	Serious (31-70%)	Unknown	
10.1	Volcanoes					Not applicable.
10.2	Earthquakes/tsunamis	Low	Small (1-10%)	Serious (31-70%)	Unknown	Tsunamis are uncommon in the Atlantic Ocean, and are an unlikely threat in the short term. In the event of a tsunami there would likely be significant damage to floral vegetation, erosion of habitat, and potentially damaging submersion of nests.
10.3	Avalanches/landslides					Not applicable.
11	Climate change & severe weather	Medium-low	Large-restricted (11-70%)	Moderate (11-30%)	High (Continuing)	
11.1	Habitat shifting & alteration	Not a Threat (in the assessed timeframe)	Small (1-10%)	Moderate - Slight (1-30%)	Low (Possibly in the long term, >10 yrs)	Since the last ice age, rising sea levels have caused a gradual decrease in the size of Sable Island (Cameron 1965; Wright 1989). The dune systems of the island may be more unstable in recent times than they were prior to human colonization (McCann and Byrne 1994). Estimates of the island's size over the last two and a half centuries suggests a loss of as much as 35 km^2 (Wright 1989). The potential range of the bee would have been reduced greatly over this time period. Climate change is likely to increase sea level rises in the future (Houghton *et al.*1996; Shaw 2001; Kont *et al.* 2003; Environment Canada 2006). The island has a low-elevation and sea level rises will shrink the island and reduce available habitat. Global estimates of sea level rises are as great as 120 cm by 2100 (Rahmstorf 2007). In the 20th century sea levels rose by approximately 17 cm, but the rate or increase has nearly doubled in recent years (Church and White 2006). The island is continually shifting as wave action reduces material from one end of the island and replaces it on the opposite side of the island. This is part of the natural process of the island. Increasing inundation of ponds on the island by sand and sea water could lead to a loss of floral species such as Polygonum in these regions.
11.2	Droughts					

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.3	Temperature extremes	Not a Threat (in the assessed timeframe)	Unknown	Unknown	Low (Possibly in the long term, >10 yrs)	The cool climate of Sable Island (Table 2) likely limits the productivity of bees, which prefer warm temperatures (Tuell and Isaacs 2010). Extreme cold temperatures could potentially impact Sable Island Sweat Bee directly or indirectly by damaging floral hosts. Climate models for the Maritime regions suggest that the climate will become even cooler and wetter, which may put pressure on the physiological tolerances of bees on the island.
11.4	Storms & flooding	Medium - Low	Large - Restricted (11-70%)	Moderate - Slight (1-30%)	High (Continuing)	Sable Island regularly experiences strong winds (Table 2) and is subject to storms and flooding. Climate change is expected to increase storm frequency and severity in the region (Keim *et al.* 2004). Extreme weather conditions increase the rate of erosion and loss of vegetated areas. The last hurricane resulted in the largest documented flooding of the habitat by sea water. The effect of this flooding on vegetation or the impact of submersion of Sable Island Sweat Bee nests requires study. There are at least three areas on the island that are at risk of being breached if sea levels and flooding continue. Breaching would result in separation of Sable Island into multiple land masses and could potentially significantly reduce the amount of available habitat for the bee.

Invasive and Other Problematic Species and Genes (IUCN Threat 8)

Invasive non-native/alien species (8.1)

Sable Island has a resident population of naturalized horses. The current population of horses may have been introduced in approximately 1760 (Christie 1995). The impact of the feral horse population on Sable Island Sweat Bee is unclear and requires additional study. Trampling of vegetation or nest sites by the horses is potentially damaging either directly or through increased erosion (Freedman *et al.* 2011). Horses preferentially consume Marram Grass (*Ammophila breviligulata*), which is the primary plant sand-binding species responsible for preventing erosion. This large herbivore has the potential to also consume valuable floral hosts of the bee. However, feral horses may also help structure the sand ecosystem, allowing forbs to compete with grasses on the island and enable the open sand ecosystems to remain as such. Since the bees and most plants likely precede the presence of the horses by several thousand years this possible benefit may not be required. Population sizes vary from 150 to 400 to horses (Lucas *et al.* 1991) so there may be significant year-to-year variation in the impact of the horses. Horses have not been culled since 1960 (Plante *et al.* 2007) so their populations may be on the rise. Recent estimates put the horse population near its maximum (Lucas *et al.* 2009). Additional research on the effect of horses on the Sable Island Sweat Bee and its floral hosts using horse exclosures is needed (Freedman *et al.* 2011).

If other bees were introduced to the island then they could potentially impact the Sable Island Sweat Bee through competition or introduced disease. In the past, bees have been intentionally and unintentionally transported during human activities, but this has primarily been cavity-nesting species (Cane 2003). Nest sites for cavity-nesting bees would be limited to areas near buildings or other structures, which would minimize the impact and likelihood of establishment of these bees. The megachilid bees on the island are both ground-nesting species although cavity-nesting is common in this family, which may be indicative of the few nesting opportunities for cavity-nesting bees. Transportation of ground-nesting species is unlikely since it would require movement of large amounts of soil. Nevertheless, there are cases of ground-nesting bees becoming established outside their native range (e.g. Magnacca *et al.* 2013). The broad floral host range of the Sable Island Sweat Bee also may help it escape competition from other species.

Other invasive insects, such as ants or bee-attacking insects, could potentially impact the Sable Island Sweat Bee. Additional surveys of the insect fauna to monitor any changes are needed. The last extensive faunal list for Sable Island was published by Wright (1989), and much of this was based on earlier literature (e.g. Howden *et al.* 1970).

Introduction of an invasive plant species to the island could be problematic to the Sable Island Sweat Bee and its habitat. These could be transported through numerous pathways, including seeds being moved in clothing and shoes of tourists. The harsh conditions of the island (*e.g.* cool summer climate, high sand content, and heavy inundation of salt water) is likely to limit the number of invasive species that could successfully establish themselves on the island. Nevertheless, any invasive plant that interferes with the natural ecosystem of the island could be potentially harmful to the Sable Island Sweat Bee. Some of the plant species on the island are non-native (Catling *et al.* 1984) and some such as Scottish Heather - *Calluna vulgaris* (L.) (Ericaceae) Hull may be increasing in population size.

Problematic native species (8.2)

Grey seals (*Halichoerus grypus*) on the island have the potential to damage vegetated areas during the winter months when they come inland. Grey seal populations increased exponentially over several decades during the late 20th century (Bowen *et al.* 2003), although this population growth has declined (Bowen *et al.* 2007). During winter months, the seals move inland and occupy the lowland terrestrial areas of the island, although it is unknown how this impacts the bee overwintering sites and dormant floral resources.

Climate Change and Severe Weather (IUCN Threat 11)

Habitat shifting and alteration (11.1)

Since the last ice age, rising sea levels have caused a gradual decrease in the size of Sable Island (Cameron 1965; Wright 1989). The dune systems of the island may be more unstable in recent times than they were prior to human colonization (McCann and Byrne 1994). Estimates of the island's size over the last two and a half centuries suggests a loss of as much as 35 km^2 (Wright 1989). The potential range of the bee would have been reduced greatly over this time period.

Climate change is likely to increase sea level rises in the future (Houghton *et al.*1996; Shaw 2001; Kont *et al.* 2003; Environment Canada 2006). The island has a low elevation and sea level rises will shrink the island and reduce available habitat. Global estimates of sea level rises are as great as 120 cm by 2100 (Rahmstorf 2007). In the 20^{th} century sea levels rose by approximately 17 cm, but the rate or increase has nearly doubled in recent years (Church and White 2006).

The island is continually shifting as wave action reduces material from one end of the island and replaces it on the opposite side of the island. This is part of the natural process of the island. Increasing inundation of ponds on the island by sand and sea water could lead to a loss of floral species such as *Polygonum* in these regions.

Storms and flooding (11.4)

Sable Island regularly experiences strong winds (Table 2) and is subject to storms and flooding. Climate change is expected to increase storm frequency and severity in the region (Keim *et al.* 2004). Extreme weather conditions increase the rate of erosion and loss of vegetated areas. The last hurricane resulted in the largest documented flooding of the habitat by sea water. The effect of this flooding on vegetation or the impact of submersion of the Sable Island Sweat Bee nests requires study.

There are at least three areas on the island that are at risk of being breached if sea levels and flooding continue. Breaching would result in separation of Sable Island into multiple land masses and could potentially significantly reduce the amount of available habitat for the bee.

Human Intrusions and Disturbance (IUCN Threat 6)

Recreational activities (6.1)

Sable Island is protected under the *Canada National Parks Act*. Direct human impacts on the island are limited by its national park status (see Habitat Protection and Ownership) and its isolation from the mainland. Sable Island has limited number of regular occupants and research activities. It is occasionally visited by tourists, either by chartered flight or cruise ship. Many activities are prohibited on the island, but human foot traffic can potentially increase erosion on dune slopes and vegetated areas and ultimately damage sensitive bee habitat. It is expected that tourism on the island will increase with its establishment as a National Park. There are plans for tourist cruise ships to visit the island. Each ship could bring 100 or more visitors to the island, which represents an increase over recent tourism. Visitors are monitored and given an orientation to the island by park staff, which should further limit impacts of increased tourism. Increased visitation will increase the probability of introduction of invasive species.

Geological Events (IUCN Threat 10)

Earthquakes/tsunamis (10.2)

Tsunamis are uncommon in the Atlantic Ocean, and are an unlikely threat in the short term (Clague *et al.* 2003), but their occurrence is unpredictable. An earthquake or landslide on the Laurentian Shelf could cause a tsunami with waves that could reach Sable Island (Fine *et al.* 2005). In the event of a tsunami there would likely be significant damage to floral vegetation, erosion of habitat, and potentially damaging submersion of nests.

Limiting Factors

Harsh weather could potentially limit foraging activity of the Sable Island Sweat Bee. Typical weather conditions during summer on Sable Island are often relatively cool and foggy, which is suboptimal for most bees. Wind speeds average nearly 25 km/h, which is above what is considered optimal for bee foraging (Tuell and Isaacs, 2010). Year-to-year variation in weather patterns could affect population levels due to decreased foraging activity in extreme conditions. Strong winds can also lead to increased erosion levels and the burying of flowering vegetation under sand.

Number of Locations

Sable Island Sweat Bee is considered to have fewer than five locations on the isolated Sable Island. The most likely threat to this location is the inundation of the island due to severe weather or rising sea levels. The low elevation of the island means that rising sea levels expected due to climatic changes could greatly decrease the amount of available habitat. Severe storms, including tsunamis caused by earthquakes on the Laurentian Shelf, can potentially inundate the island with sea water. Frequent and continued submersion of underground nests by seawater could potentially have severe impacts on the Sable Island Sweat Bee.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

There are no federal or provincial laws that specifically protect the Sable Island Sweat Bee, mitigate threats to this group or protect the species' nest sites or habitat.

Non-Legal Status and Ranks

The Sable Island Sweat Bee has not been assigned a global status rank (NatureServe 2014). Provisional conservation status ranks for this species using NatureServe (2014) methodology recommend a global rank of G1 (globally critically imperiled), national rank of N1 (nationally critically imperiled) and provincial rank of S1 (critically imperiled).

Habitat Protection and Ownership

The global and Canadian range of the Sable Island Sweat Bee is entirely within the Sable Island National Park Reserve, which was established in July 2013. Parks Canada will develop a Management Plan for Sable Island National Park Reserve within five years following legal designation under the *Canada National Parks Act*. Interfering with the native flora and fauna is prohibited. Vehicular travel is limited to researchers and park staff and is restricted to certain areas. Various other activities are prohibited such as walking on steep dunes, unstable vegetation, fires, pets, littering and camping. In practice, some prohibited activities (e.g. walking on dune slopes) would be difficult to enforce due to the limited number of park staff.

Direct human impacts on the island are limited by its national park status and its isolation from the mainland. The island is approximately 280 km from Halifax. Visitation to the island requires registration, but is not strictly controlled. Visits to the island are primarily through chartered flights, cruise ships and private boat tours. The expense of flights and the frequent interference of extreme weather conditions tend to limit travel to the island. The recent conversion to a national park reserve means access to the island is now under the control of a different agency. It is possible that its new status as a park may lead to increased visitor traffic due to ecotourism. Should Parks Canada seek to accommodate tourism on the island through construction of boardwalks or other facilities it could have negative impacts on nesting sites.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Jason Gibbs completed his PhD at York University in 2009. His main research area is the systematics of bees with a focus on the genus *Lasioglossum* in the family Halictidae. He has completed three large-scale revisions of *Lasioglossum* species in North America including the species of *Lasioglossum* in Canada. He described *Lasioglossum sablense* as a new species in 2010. As a post-doctoral researcher at Cornell University Dr. Gibbs completed, with help from colleagues, the most comprehensive phylogeny of *Lasioglossum* published to date. In 2013 he began a new position as Research Associate in the Department of Entomology at Michigan State University. He is currently involved in a large-scale project studying pollinators of specialty crops. He is still involved in ongoing efforts to study systematics of *Lasioglossum*.

COLLECTIONS EXAMINED

Material from the Canadian National Collection of Insects, Arachnids and Nematodes (CNC) was examined specifically for this report. Prior to preparation of this report tens of thousands of specimens of *Lasioglossum* were examined from more than two dozen collections in Canada and the United States, including material from Maritime Provinces and New England states as part of ongoing taxonomic studies of halictid bees. The type series, deposited at Packer Collection York University (PCYU) and the CNC was examined during the original species description (Gibbs 2010). Relevant material examined includes specimens from PCYU, CNC, and collections from Agriculture and Agri-Food Canada Atlantic Food and Horticulture Research Centre in Kentville, Nova Scotia.